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# Peer Evaluation of Master Programs: Closing the Quality Circle of the CDIO Approach?

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## ABSTRACT

*A quality assurance project was conducted within the framework of the Nordic Five Tech Alliance (N5T), a strategic alliance of the five leading technical universities in Denmark, Finland, Norway, and Sweden. The project concerned the development of a common quality enhancement tool for conducting peer evaluations of educational programs to enable their further development and close the quality circle. In addition, the project will contribute to the consolidation of the N5T alliance by facilitating contacts between faculty members and providing them with an in-depth knowledge of the study programs within their field at another N5T institution. The article describes the quality enhancement tool in detail, its contribution to the development of the involved programs, and how international peer evaluation can contribute to closing the quality circle. Finally, it assesses the value of the approach to contribute to the creation of long-term relationships in educational networks.*

**Keywords:** *CDIO, Higher Education, Peer Evaluation, Quality Assurance, Self-Evaluation, University Collaboration*

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## INTRODUCTION

How can we conceive, design, implement and operate the best possible educational programs for the benefit of students, industry and our

technical universities? This is – to put it bluntly – what the Conceive, Design, Implement and Operate (CDIO) approach is all about (Crawley et al., 2007).

This article describes a quality assurance project, which is conducted within the framework of the Nordic Five Tech Alliance (N5T),

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a strategic alliance of the five leading technical universities in Denmark, Finland, Norway and Sweden:

- Aalto University, Finland (Aalto)
- Chalmers University of Technology, Sweden (Chalmers)
- Norwegian University of Science and Technology, Norway (NTNU)
- Royal Institute of Technology, Sweden (KTH)
- Technical University of Denmark (DTU)

The project is concerned with the development of a common quality enhancement tool. The tool is designed for conducting peer evaluations of educational programs enabling further development of the study programs involved, and thereby it is contributing to closing the quality circle, which is embedded in the CDIO approach. In addition, the project aims to contribute to the consolidation of the N5T alliance by facilitating contacts between faculty members and providing them with an in-depth knowledge of the study programs within their field at another N5T institution.

The overall objective of the quality enhancement tool is to ensure that the students can study in environments where their development of relevant and excellent knowledge, skills, competencies and values is optimal. These skills, competencies and values must be fit for industry needs and at the same time they should make the future engineers able not only to develop, change and improve industry practices, but also to work with research. This objective is supported by program benchmark evaluations with peers in order to analyse one's own practice, identify one's own strengths and weaknesses, as well as to learn from peers within the same engineering domain.

The article describes the quality enhancement tool in detail and analyses its impact on the curriculum development quality of the teaching and learning within the involved programs. Furthermore, it outlines how international peer evaluation can contribute to closing the quality circle embedded in the CDIO approach.

The article is structured as follows: We begin by reviewing current trends in quality assurance (QA) of higher education, and single out the motives for complementing national QA framework with local ones, specifically peer evaluation frameworks. We then describe our method, followed by an account for how it has been applied to evaluate seven pairs of master programs in two different projects in 2009-2011. The discussion section mainly considers the program directors' perceptions of the peer evaluation model and the article is wrapped up with a list of conclusions and ideas for future work.

## CURRENT TRENDS IN QUALITY ASSURANCE OF HIGHER EDUCATION

Demanding high quality in all services and activities seems to be a general trend in all parts of society. Everyone and everything is measured and compared in order to ensure that every performance is a good value for the money. The quest for quality and accountability is omnipresent. In line with this trend, government control of higher education (HE) has become more predominant (Rozsnyai, 2003), and the advent of market forces in HE has challenged the *academic oligarchy*. For quite some time *accountability* has been the buzzword in order to ensure value for public money (Gray, Patil, & Codner, 2009).

However, it is not always made explicit what is actually meant by quality. Quality is somehow a very indistinct concept and can probably be placed in the category of concepts which can be identified as an essentially contextual concept, very much depended on personal preferences as well as being multidimensional and complex (Dahler-Larsen, 2008). And since the quality of teaching and learning are some of the most complex and difficult areas to measure the increasing demand for and focus on quality in HE is even more challenging (Dahler-Larsen, 2003).

During the last three decades, quality assurance (QA) has been an integral part within European Higher Education (HE). Many different concepts have flourished in this growing quality movement. Initially these discussions were not very prominent in the Bologna process (Jeliaskova & Westerheijden 2002). Rather, one of the main rationales for the initiatives in the Bologna declaration was to strengthen the international competitiveness of the European system of HE because Europe had lost its dominant position as a destination for overseas study (Der Wende & Westerheijden, 2001). Thus, attracting students to European HE was a crucial task. However, as Saarinen (2005) demonstrates, the meaning and understanding of quality in the Bologna process moved from *promotion of competitive edge* to establishing *quality assurance techniques* including program or institutional accreditation. The pressure towards more quality assurance has continued to increase, and QA has become an essential building brick in the European Higher Education Area (Haug, 2003), and a central activity at many universities at all organisational levels.

The main idea in the Bologna process concerning QA is that the primary responsibility for quality assurance processes in higher education lies with each institution itself. This is combined, however, with national quality assurance activities such as accreditation systems and evaluation of programs or institutions, including internal assessment, external review, participation of students, and the publication of results. This is all part of the European standards and guidelines (ESG) framed by ENQA, the European Association for Quality Assurance in Higher Education (European Association for Quality in Higher Education, 2005).

In many European countries, national accreditation agencies have been created. Most agencies employ the standard method for assessing quality by using self evaluations, site visits, and reviews by external expert panels. The methods increase the demand for documenting study plans, results and outcomes. For example, the institutions need to document intended learning outcomes and key performance indicators

like student performance, student employment, faculty-student ratio, etc. Even though this procedure seems reasonable and purposeful from an accountability perspective, for example, by identifying poor education programs, there is a risk that universities and accreditors focus too much on documentation and threshold requirements, that is, on how they meet accreditation criteria and minimum standards while paying too little attention to improving their systems and programs (Harvey, 2005).

Moreover, key performance indicators are important measures of the quality level but they reveal little of the reasons for the results, including whether the results are due to internal or external factors of the education program. Further, governmental QA frameworks are by necessity rather general and are applied by accreditors who are knowledgeable people but not necessarily discipline experts. These frameworks often leave little time for dialogue between the accreditor and the evaluated. In the face of risking a negative evaluation and thus losing accreditation, a program may adopt a defensive approach to the accreditors and be less willing to point out areas for improvement. As a result, government QA frameworks may be perceived as of limited help when aiming to improve a program beyond the threshold for accreditation.

By contrast, peer evaluation is defined as: the process of self-regulation by evaluation involving qualified individuals within the relevant field (Wikipedia, 2011). Such an evaluation yields feedback from people within the discipline and the possibility to focus the evaluation on selected relevant issues. It also encourages dialogue about and ownership of the process. And it allows a discussion where weaknesses can be admitted and discussed. Further, if the peer evaluation is mutual, that is, two programs cross-evaluate each other, the process can provide an opportunity to learn by studying someone else and open opportunities to develop or enhance collaborations. If a peer evaluation framework is aligned with governmental QA frameworks it will also facilitate future external evaluations. In the next section, we will outline

the method for peer evaluation of engineering programs that we have developed and tested.

## THE PEER EVALUATION METHOD AND PROCESS

The peer evaluation approach in this project is anchored in the European Standards and Guidelines (European Association for Quality in Higher Education, 2005) and at the same time inspired by Deliberative Democratic Evaluation (Howe & Ashcroft, 2005; Hansen, 2004; House & Lowe, 2000) and explanation-oriented evaluation theory (Franke & Nitzler, 2008).

The European standards provide an overall reference framework for the evaluation, putting the education into a time and educational context and serving as guidance in data collection and interpretation of collected data. The standards further serve to create a holistic perspective of the programs to be evaluated.

The Deliberative Democratic Evaluation model aims at generating a learning process for the key players within the evaluation process itself giving them the opportunity to develop their knowledge and understanding of the problems and challenges raised by the evaluation. In that sense the evaluation model is aiming at creating a dynamic and creative process where new opportunities and old understandings meet and interact (Hansen, 2004). According to Jennings (1993) the model, first, enables the assessment of the relevance, strength and meaning of the problems in relation to the experience of the involved people. Second, the model permits the elucidation and definition of the problems so that decision makers become aware of the background of the problems as well as why various things are considered as problematic by the players. Such knowledge allows decision makers to find well-functioning and fair solutions that will satisfy more parties. Finally, the evaluation model can be future oriented and be used for selecting different actions that will please the various actors. In that sense it is claimed that the model is problem seeking in the present and problem solving for the future

while focusing on inclusion, dialogue and deliberation (House & Lowe, 2000). This includes formative evaluation, explained as an approach where the evaluation contributes knowledge that can be applied to form or to continuously develop a study program while it is given. The evaluation will give guidance to transformation rather than control, and provides a basis for how to improve quality in education.

## The N5T Model for Peer Evaluation

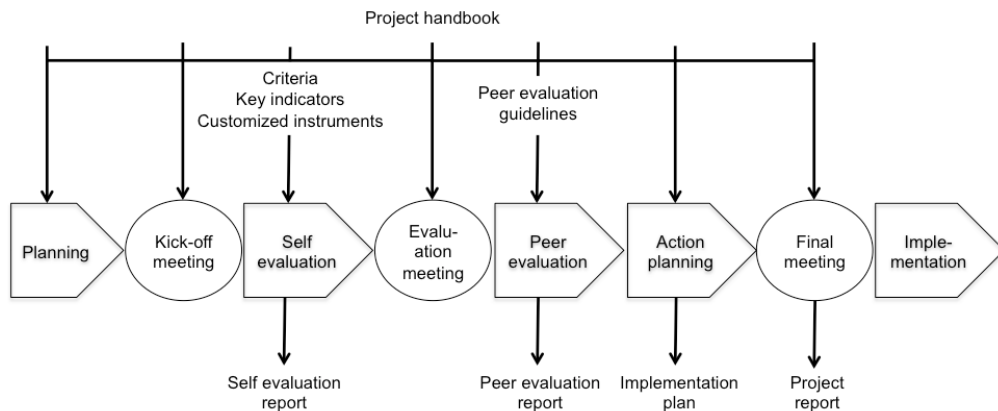
The method applied in the N5T exercise is an elaboration of a model developed at the Technical University of Denmark (DTU), which was built upon the principles and methods referred to above. The process has five distinct phases, connected by three meetings. The phases are:

- Planning
- Self evaluation
- Peer evaluation
- Action planning
- Implementation

The process delivers four specific reports and is supported by a project handbook. The basic process is illustrated in Figure 1 and described in more detail below. The project handbook is an important tool for the evaluation process. The handbook describes all elements of the method with emphasis on the set of criteria to be used in the exercise. The handbook also describes supplementary material for the evaluation: study plans, curricula descriptions, structure of the program, course descriptions, learning outcomes, course evaluations, competence profile for the program, and M.Sc. theses.

**The planning phase.** The first phase of the process is planning. The programs to be evaluated are identified. The project handbook provides instructions on how to set up the evaluation. In addition, modifications tailored to the specific programs to be evaluated may be developed. A local review panel for each program is formed, consisting of the program director, teachers and students. The program director has the overall responsibility for the

Figure 1. N5T peer evaluation process



self evaluation process. The planning phase concludes with the kick-off meeting where the review panels introduce their programs, review the method, and make specific plans for the remainder of the process.

**The self evaluation phase.** The real work begins with a self evaluation by each of the programs. During the self evaluation process the panel should identify what is important; what are the strengths of the program; and what kinds of issues need action in study program development to be documented in the self evaluation report. The program director is responsible for writing the report. The local review panel gives inputs and assists the program director in writing the report, which has the following sections:

- Introduction. The introductory part of the self evaluation report contains a brief description of the basis and conditions of the program, including key indicators.
- Objectives of the study program. Guiding principles of the program including the content and the competence profile.
- Program and course design. Curriculum design, linking competence profile and learning outcomes, linking teaching and research.

- Training of engineering competences. Measures taken to ensure the training of engineering competences in the program.
- Delivery of education. Teaching and assessment methods used – reasons for choosing them and how they are applied.
- Continuous development. Procedures used to identify critical points in courses, course sequences, the curriculum, the program as a whole and how the problems are solved.

To facilitate the process, the evaluation is based on a set of criteria and key indicators. The criteria are influenced by the accreditation criteria proposed by ENQA (European Association for Quality in Higher Education, 2005). However, their purpose here is to stimulate thought and reflection, rather than to control intended to determine if the program meets some threshold requirement. Instead, these criteria are intended to initiate discussions between the program teachers, managers and students regarding the program.

In order to illustrate the character of the handbook the questions from the criterion, *objectives of the study program*, are listed here:

- What are the objectives of the program, the content and the central elements of the program (program aim, program profiles,



compulsory and optional courses, learning outcomes, career opportunities)?

- What is the balance between professional depth and broadness of the program? Why has this focus been chosen?
- How is the students' development of a distinct profile towards a professional and/or academic identity facilitated or enabled?
  - What is your immediate opinion of how the program manages this overall criterion (*objectives of the study program*)?
  - What are the essential challenges and opportunities regarding this overall criterion (*objectives of the study program*)?
  - Suggestions for actions/improvements.

The data from the analysis of the criteria are mostly qualitative. In addition, a set of key performance indicators have been identified that enables a quantitative analysis and comparison of some aspects of a program, including:

- Enrolment
- Number of graduates
- Completion rate
- Number of international students
- Number of international teachers
- Number of teachers with pedagogical education
- Tuition fee rates

The self evaluation, and later, the peer evaluation, is also supported by various kinds of supplementary material, including intended program learning outcomes, program plans, course syllabi, examples of final year reports, etc.

The self evaluation report brings together these three kinds of data in a condensed way. It should highlight important issues. It should further identify the program's strength and weaknesses, and summarize arguments and insights of relevance for development of the program. It should not exceed 10 pages.

**The peer evaluation phase.** The next phase is peer evaluation. This phase is started with the evaluation meeting. At the meeting, the programs present the analysis contained in their self evaluation report. This is followed by sufficient time for discussion to go into some depth.

On the basis of the discussions held at the evaluation meeting, each panel writes a report (2-3 pages) with conclusions and recommendations for its peer in order to further develop the program. Each panel receives a report from their peer evaluation panel. It is recommended that the report adhere to the criteria, thus describing strengths and weaknesses, challenges and recommendations in relation to the criteria. It is of major importance that critical comments are formulated constructively.

**The action planning phase.** In response to the recommendation(s) listed in the peer evaluation report, each program develops an implementation plan to address the recommendation(s). The implementation plan should comprise 2-3 pages. The program director has the overall responsibility for the plan. In the implementation plan, the panel responds to the recommendations in the peer evaluation report stating how to deal with the challenges the program is facing. The plan must contain a description of the initiatives and steps that will be taken in order to further develop the program. The implementation of the improvements is intended to be initiated immediately.

The action planning phase concludes with the final meeting. At the final meeting, the programs present their implementation plans and present a project evaluation report. In this report the thoughts and reflections from the individual panel members are compiled in order to give feedback and evaluate the N5T peer evaluation concept. The feedback is essential for the further development of the peer evaluation concept.

**The implementation phase.** After the final meeting, the programs should start implementing the changes listed in the implementation plan.

## THE PILOT PROJECT AND THE SECOND ROUND OF PEER EVALUATIONS

A pilot project of peer evaluation of master programs was formed based on the method and the experience of a similar exercise carried out internally at DTU. A working group, lead by DTU, including representatives from the five universities, was endorsed by the rectors to run the pilot project.

### The Pilot Project

One of the first tasks for the pilot project working group was to refine and formulate the set of criteria applicable for the master level. A special working group was established with the aim to define key performance indicators.

A total of six study programs formed pairs to be mutually evaluated in the pilot project:

- NTNU–Chalmers: Industrial Ecology
- KTH–DTU: Environmental Engineering
- Aalto–DTU: Mobile Computing/Computer Science

The project was run during a 6-month period from kick off in September 2009 till the final meeting in March 2010, following the phases described in Figure 1. The kick off meeting with representatives from all six panels played an important role as the panels should agree on the following issues:

- Consensus on the project model and the criteria
- Common understanding of project outcome
- Common sense of direction
- Establishment of cooperation between the study programs involved in the exercise

The pairs of programs used most of the time at the kick off to calibrate their understanding of the criteria described in the handbook. They also agreed on the schedule for the evaluation process including dates for the peer evaluation

meetings. At the final meeting the following issues were addressed in addition to the basic task of presenting and discussing implementation plans:

- Evaluation of the peer evaluation model: feedback from the evaluation panels and the project group.
- Conclusions and decisions on future design and adaptations of the N5T Peer Evaluation exercise.

The N5T rectors' found the result from the pilot project of such interest that they decided to run a second round of peer evaluations. A working group lead by Chalmers was assigned. When planning the second round of the project the working group took into consideration the first round suggestions for improvements of the method and the evaluation process but the main outline and method were similar to the pilot project.

One outcome from the pilot project was a self evaluation questionnaire which was used as a quantitative instrument to identify strengths and issues for development. The questionnaire was built upon the criteria in the handbook. The experience from the pilot project was that the questionnaire was a helpful supplement when combined with qualitative input. The questionnaire is now a part of the handbook as an optional instrument for the panels to use in the peer evaluation process. On the initiative of the participants, the questionnaire has been developed into two different sets of questions directed to students and to the teachers respectively.

The second round project will run from January-June 2012 with the following participating programs:

- DTU–Chalmers: Biotechnology
- NTNU–Chalmers: Industrial Design
- NTNU–Chalmers-KTH: Industrial Economy
- KTH–Aalto: Wireless systems



There are two major differences concerning the second round participating programs compared with the pilot project, in that three universities participate in the peer evaluation of Industrial economy. Moreover, the evaluations of the Industrial Economy and Industrial Design programs focus on five-year integrated B.Sc.-M.Sc. Eng programs rather than only two-year masters programs. The panels of these three programs have customized the model to suit the needs of the evaluation of the longer programs. The customization indicates that the method used in the project is not generally applicable, but modifiable. The final evaluation of the second round project will therefore especially focus on whether the method without considerable changes can be generalized to cover all levels of education at university level.

There was a mutual understanding among the working group members that the time and resources spent on the peer evaluation process should not be increased, a viewpoint built on a *cost-benefit* discussion. The participants of the evaluation should be able to go through the process more or less within their daily work.

## DISCUSSION

The peer evaluation model has been evaluated by the participants in terms of outcome, benefits and suggestions for improvement. In the project evaluation reports, the evaluation panels assessed the method and the process applied and made suggestions for future improvements. The evaluation has taken place on two occasions, first, in conjunction with the final meeting of the pilot project. And then, after a year, four program directors were interviewed with the aim of getting their views with a time perspective. (Interview participants are coded as A-D to provide anonymity.) It was felt that with this time perspective one might get a clearer picture of if, how and why the project fulfils its main objectives. Below, we summarize the main findings of the evaluations of the pilot project.

### Self Evaluation was Time Consuming but Worthwhile

None of the program directors had previous experience with a similar evaluation. All directors found the self evaluation phase of the project quite challenging and time consuming. There were many questions to answer, and some were perceived as too difficult to understand, and others overlapped.

Although B's local program group started off with high ambitions, they didn't answer all questions at the end. D eased the workload by not having group meetings with his local project group – instead he interviewed teachers and some students. However, all program directors agreed that the self evaluation was very useful and important. B said that writing their report was more enriching than reading their partner program's report. C emphasized that writing a self evaluation is very important for your own sake.

Since it is very time consuming to write the self evaluation report, it is challenging to broaden this project to more programs. Approaches for making this phase more efficient are essential if one wishes to scale up the project. One possibility could be to ask programs to do a SWOT analysis of their program before or during the kickoff. Based on this, the partner program, and the project leaders could discuss which questions they should focus on, for instance. Perhaps they might also come up with new questions or focus areas. Doing this, the purpose of the project would perhaps also be clearer: that it aims to be problem seeking in the present and solution searching for the future.

### The Peer Evaluation Process Worked Well

In general, the participants were pleased with the process, and with the match of the programs. They further stated that an open-minded and honest dialogue between peers characterized the collaboration. The evaluation process was

perceived as well structured and scheduled. The handbook gave precise instructions and helped to keep the evaluation in focus. The workload was considered reasonable, the self evaluation report being the most time-consuming element. The overall organisation of the project was positively evaluated.

The main conclusion the four program directors (A, B and C and to some extent D) had about the peer evaluation process is that it led to deep and constructive discussions and meetings that were very difficult to arrange and create on one's own initiative. "This was organized for us", B said and emphasized that any effort they have made in doing something similar, like visiting another institution has not led to as deep discussions, constructive feedback or action plans. "The N5T peer evaluation project forces you to spend some time on [working with evaluations and improvements on program level]", said A. And D added that the thinking process was of great worth. It made them consider what is important and to retrieve this feedback from teachers and students at their institution. D's institution has used the evaluation report from N5T peer evaluation project as a model for the university's self evaluation process.

It can further be argued that the self evaluation and the discussions and reflections during the whole process have encouraged creating informal and maybe implicit local communities of practice involving a smaller or larger part of the teachers in some of the programs. Therefore, it is possible that in the long run an activity such as peer evaluation of programs could strengthen the scholarship of teaching among the involved faculty (Bowden & Marton, 1998; Boyer, 1990; Wenger, 1998).

### **The International Peer Element Provided Unique Input**

The evaluation panels all agreed that the strength of the project lies in the fact that it is an international peer review and the project was considered unique in the way that it allowed for international peers to learn about and evaluate each other's programmes. Similar internal

evaluation projects that bring programs together from different fields are not able to provide this perspective. The participants found that it was interesting and valuable to discuss how to systematically evaluate quality aspects of their programs with a peer from another program in the same field. Thus, for a program director always looking for ways to improve a study programme and its QA procedures, this project offered an attractive setting.

Contacts had been established between program directors and teachers in the peer programs, which can serve as the initiation of long-term, strategic relationships, for example, for setting up joint master's degree programs. The method served as a tool in structuring the dialogue between the programs. However, to make an international peer review work, the programs must have rather good insight into the national constraints in the other country. Therefore, it is suggested that an introduction to the national educational systems of the various peer programs be held at the initiation of a project.

### **A Focus on Differences**

When asking program director B what other points on the list of possible strengths and weaknesses were discussed, and asking specifically for the pedagogical processes in the education that has not been mentioned, B stated that the things that were similar weren't discussed very much. They had similar pedagogical methods and therefore did not dig deeper into that. Instead they looked at differences: "It was where we are different there will be more discussion." The main difference between B's and the partner's program was the curriculum – B's being very multidisciplinary (natural science, engineering science, architecture, social science) compared with a more or less engineering science perspective in the partner's program.

Another difference was the freedom that students may or may not have when choosing which courses to take. B pointed out that the freedom to choose used to be higher, but this clearly decreased with new education policies.

Since B's partner program A could see that the quality of students' choices were high, B incorporated this in the development plans, and have implemented this to Fall 2012.

A put it like this: "Yes we got good ideas for improvement even though the two programs are very different". Also C, in reasoning about what was most helpful with the discussions stated that it was very good to have a partner in the same field of study, both for evaluation and for networking. The feedback and action points are now based on the partners' strengths and differences compared with C's program.

### **Coming Home with an Action Plan—Change Management for Program Directors**

The participants found the exercise productive in identifying strengths and risks for the future development of the masters programs involved. Two programs had already in March 2010 changed procedures or applied new initiatives, and one program had formulated a specified action plan. In one case, the method will be integrated as part of the internal QA processes at the faculty. The following are two concrete examples of planned changes.

C had an agenda when enrolling in the project and was quite aware of the program's strengths and weaknesses. C described that even before entering this project there was good contact with all teachers. The weaknesses C wanted to get feedback on and solutions for were related to students' first study periods (too theoretical with low contact with applications, real life and industry) and program structural questions (no clear tracks for all eligible courses, only control over mandatory courses, not enough selection of courses). C was lucky to have a partner whose strength was just exactly this (applied course during the first study period and clear study tracks). So when returning home, C had a clear agenda on what to do and how. Simultaneously, all programs at C's institution went through a major re-structuring process, with the aim of having fewer and broader programs. Therefore, C could use the feedback and change agenda

from the NST project, and believes that this has led to a well functioning program.

Although B had not had the actual implementation plan as a physical live document in hand when working with the program, B argued that the main points raised have been at the back of the head throughout education, program and curriculum development. This goes for using their strength (multi-disciplinary field) and for improving their weaknesses (no well defined learning objectives or clear focus of the program, some overlaps and some discrepancies between the courses and too little freedom for students to choose courses). B stated that this was why they signed up for this project: to be able to return home to fellow teachers with an action list on improvements needed. "That was the ambition", B added and went on to say that things have gotten in the way, mostly due to other changes needed with the program, but they still have all this in mind to work with during the coming years. B stated that there is good morale among the teachers and a mandate to run this program. They now run program development meetings with a small group consisting of director B, teachers, the study coordinator and the study counsellor. Their ideas are discussed in two departments. B could clearly see that the teachers start with "marking their territory" and finally end up with questions like "what are we supposed to teach?" B concluded that, "this is some of the renewal that I have been seeking."

### **CLOSING THE CDIO QUALITY CIRCLE**

On the general level, the CDIO framework can be seen as an instrument for enhancing quality in engineering education and on a more specific level the 12 CDIO Standards address program evaluation by highlighting the need for a system that evaluates programs against the standards and provides feedback to students, faculty and other stakeholders for the purpose of continuous improvement of the program (Crawley et al., 2007; Gray, in press). How this program evaluation should be designed and/or conducted is

not specified but it is suggested that evidence of overall program value can be collected using various methods such as focus group interviews, questionnaires and surveys, follow-up studies with graduates, course evaluations, teacher reflections, reports of external reviewers and many more (Crawley et al., 2007). Generating the evidence should be part of a continuous program improvement process that examines: input, processes, outcomes and improvement.

The peer evaluation system that we have developed is just one element in such a system that evaluates the program. However we find that it is a highly valuable part since it generates feedback and insights from peers who know the subject and the possibilities and pitfalls of the program. This is done in an atmosphere of confidentiality, equality and mutual trust, and there is an explicit absence of control. In this way the members of the N5T alliance, but also all the members of the CDIO community can help each other improve the quality of their programs – if they engage in similar peer evaluations.

Specifically, it was suggested that the handbook can be used as a tool for continuous development. It gives guidelines not only for evaluation but also for developing and planning the educational system and courses. After each evaluation process, feedback on the process should be collected and used to further develop the handbook.

## CONCLUSIONS AND FUTURE WORK

Governmental frameworks for quality assurance of higher education in line with the ENQA standards have become the norm across the world. Such frameworks are valuable in the sense that they identify minimum standards for degrees. However, they provide less support for improving a program beyond the threshold values required for accreditation. Peer evaluation methods, where two similar programs cross-evaluate each other based on evaluation criteria that they have mutually agreed on,

offers the potential of a more constructive evaluation process that is more insightful, is more focused, minimizes documentation and can be used to build long-term collaboration between the programs.

We have developed a model for peer evaluation of master's degree programs applicable within the broad domain of engineering education. It comprises five main phases – planning, self-evaluation, peer evaluation, action planning and implementation. A handbook supports the process. The model has been successfully applied in seven peer evaluations.

The model provides the programs with an international perspective and thus serves to establish an international benchmark, providing input that programs cannot get from within their home university. Further, the evaluated programs have found the model useful in identifying strengths and risks for future development. The model supports an evaluation rich with dialogue. Discussion of differences was identified to be the driving force that leads to learning experiences and action points. From a practical point of view, the participants have appreciated the proper level of structure and found the workload acceptable.

Our experiences so far indicate that the model can be customized and expanded beyond its original scope, for example to five-year engineering programs, and to evaluations with more than two participating programs.

Future work and follow-up of the method will consider:

- Evaluation of the process. Up to now, only some preliminary evaluations of the process have been conducted. More comprehensive evaluations are needed to understand the general value of the process.
- The scalability of the method. How many programs can be involved in an evaluation, and how much customization is practical when many programs of an institution are evaluated?
- Long-term effects. One aim of the model is to seed long-term collaborations between the peer programs. It would be interesting

to re-visit the programs in, for example, five years time and study if this has become reality.

- Contributions to success in governmental evaluation. A principle of the model is to be aligned with governmental QA frameworks, and thus prepare the programs also for this kind of evaluation. Whether this is realized in practice should be followed up.

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